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Chemical bath deposition of bivo4 thin films on fluorine doped tin oxide substrate for efficient solar water splitting

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Fossil fuels are the world primary energy source which fulfils 90% of the global energy demands but their supply would be sufficient only for next few generation and also releases a very heavy amount of green house gases to the environment; therefore concerns about environmental problems (Climate change) and increasing global energy demands diverged the focus of modern researchers to commercialize an alternative energy source which is less hazardous, environmental friendly, technological feasible and economical to the community. The most emerging technology of semiconductor base solar water splitting under irradiation of sun light in a photoelectrochemical (PEC) cell to produce hydrogen fuel, is consider as worldwide and one of the most hopeful solutions to solve the severe problems of energy shortage and environmental concerns. Hydrogen obtained from water splitting can be used as a green, clean, cheap, easily accessible and renewable fuel with zero emissions as it is obtained from earth abundant reserve which is water, covering 71% of earth surface. Photoelectrode is an integral component of the PEC cell and plays a central role in light absorption, charge separation, and oxidation reaction. Bismuth vanadate (BiVO4) has attained an important recent attention because of its good ferroelasticity, high charge separation, good transport properties, being stable in aqueous medium and its photo catalytic activity for splitting of water to hydrogen and oxygen. However, its direct growth on conducting substrate such as FTO is challenging and the use of surfactants, complexing agents, and seed layer has been frequently reported. In this work, Bismuth vanadate thin films were deposited on FTO glass substrate through chemical bath deposition without any seed layering. Chemical bath deposition produces uniform, thin, stable and adherent films on the surface of substrate with very good reproducibility also this method is simple, environment friendly and cost-effective. The deposition temperature, concentration, annealing temperature and the mole ratio of bismuth and vanadium were controlled to optimize the growth conditions. The effect of the growth temperature, reaction time and annealing temperature on the resulting BiVO4 film morphology was investigated using X-ray diffraction technique (XRD), scanning electron microscopy (SEM) and UV-Vis spectroscopy. The coated thin films exhibit a monoclinic crystal structure as revealed by XRD. UV visible spectra showed a strong absorption at 560 nm, and a band gap ~ 2.4 which is consistent with literature. The optimized film showed water splitting photocurrent density of 0.76 mA.cm-2 at 2 V versus RHE under standard illumination 1 sun conditions (AM 1.5, 100 mW/cm2) when used as photo anode in PEC cell for water splitting reaction.

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